Vann, Bradley

From: Barnett, Felicia
Sent: Wednesday, March 11, 2015 2:36 PM
To: Vann, Bradley
Cc: Weber, Robert; Anita Singh
Subject: West Lake Sampling Locations - Technical Memo
Attachments: AttachementA_WestLakeAddedSampleLocations.pdf; SERAS-106-DTM-031115_52.doc; SERAS-106-DTM-031115_52.pdf

Hi Brad:

Please find attached is the final technical memo for the West lake Municipal Landfill Site.

If you have questions, please let us know.

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LOCKHEED MARTIN

Date: March 11, 2015

To: Felicia Barnett, Director SCMTSC, EPA

From: Anita Singh, Ph.D., SERAS Statistician

Through: Richard, Leuser, SERAS Deputy Program Manager

Subject: SAMPLING LOCATIONS FOR COLLECTING ADDITIONAL SOIL SAMPLES TO DELINEATE THE EXTENT OF RADIOLOGICALLY IMPACTED MATERIALS PRESENT IN AREA 1, AREA 2, AND BUFFER ZONE/CROSSROAD PROPERTIES OF OPERABLE UNIT - 1; WEST LAKE MUNICIPAL LANDFILL SITE, BRIDGETON, MISSOURI

Operable Unit-1 (OU-1) of the West Lake Landfill Site (Site) shown in Figure 1 below consists of highly radiotoxic wastes with total radium, total thorium and uranium identified as the main radionuclides (RADs) of concern. These RADs are detected at levels above background concentrations within the areas of concern (AOCs) including: Area 1 and Area 2 of OU-1, and also within a narrow strip of an adjacent property called the "Buffer Zone/Crossroads Property" (Strip) [Figure 1]. The radiological constituents in Areas 1 and 2 occur in soil materials that are intermixed with and interspersed within the overall matrix of landfilled refuse, debris, fill materials and unimpacted soil and quarry spoils. The radiologically impacted waste materials are distributed in various quantities and concentrations across, under, and in approximately 28 acres of the landfill. In some portions of the two AOCs, radiologically impacted materials (RIM) are present at the surface; however, the majority of the radiological occurrences are present in the subsurface (7 to 12 feet or deeper) beneath these two AOCs. A map showing the existing soil boring sampling locations in the two AOCs is shown in Figure 2.

Section 1.0 of this Technical Memorandum (TM) contains the general background information and sampling activities that have been performed at the Site. Section 2.0 describes the objective of identifying soil boring locations to perform additional sampling so that RIM extent in outer areas of the Landfill can be determined. In order to address this objective, familiarity with the existing status of the Site was required. Therefore, a detailed review of the available Site maps and locations that have already been sampled by the NRC and the Site Respondents(e.g., West Lake Landfill) as described in the revised OU-1 Supplemental Feasibility Study Report (SFS Report) prepared by EMSI (December 2011) was performed. During a conference call held with EPA personnel, it was decided that the new sampling locations will be shown on the larger poster maps of the Site AOCs. Section 3.0 provides several Site maps from the SFS report and provided by Mr. Vann of Region 7 [R7]. Section 4 presents a summary of the proposed sampling locations shown on the maps which have already been mailed to Mr. Vann via FedEx (see figures in Attachment A; new sample locations are marked in magenta).

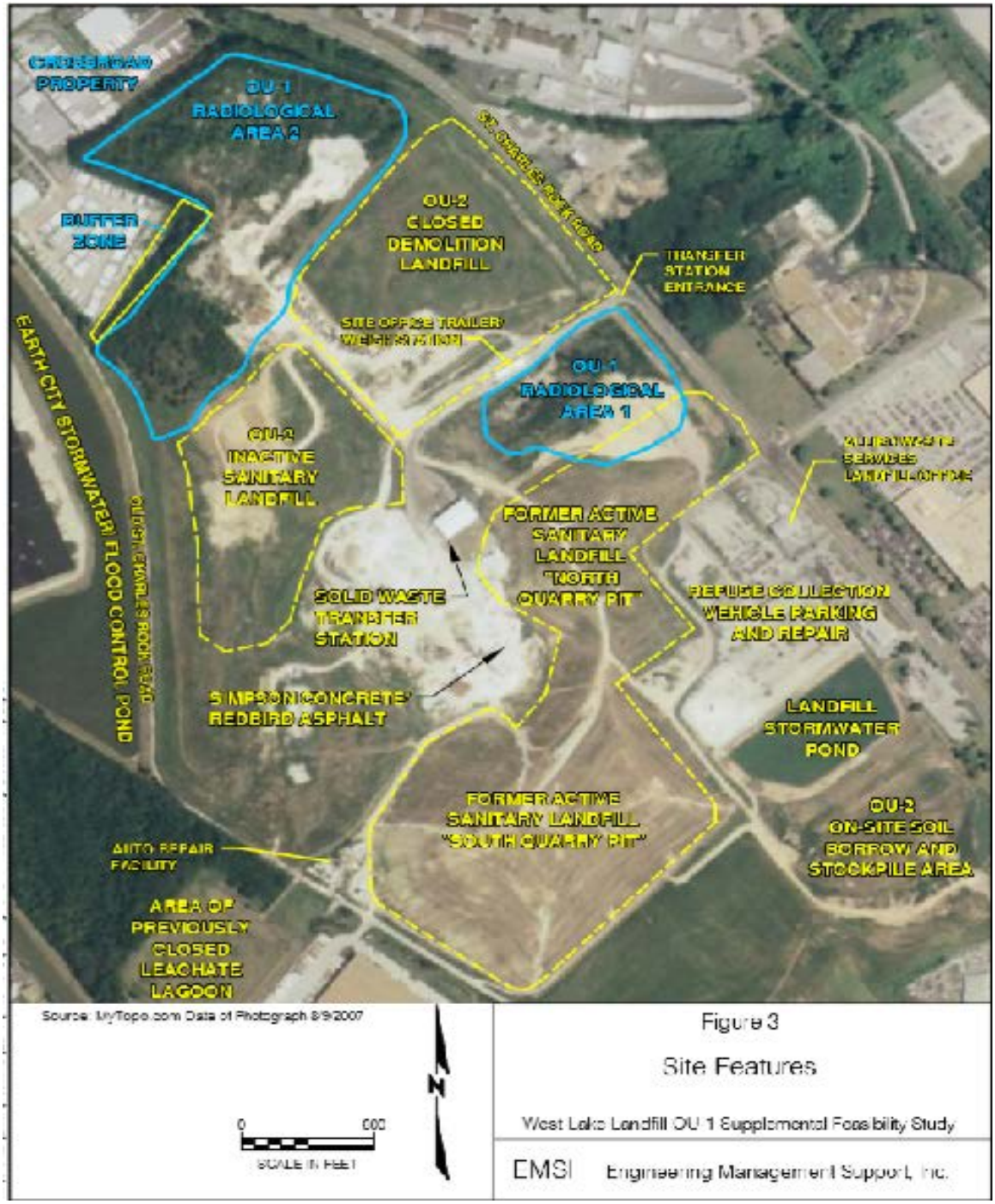

Figure 1. Landfill Map Showing Two Areas: Area 1 and Area 2 of OU-1 and Strip

Figure 2. Sampling Locations of Two Areas: Area 1 (lower) and Area 2 (upper) of OU-1

1.0 Background Information

Since the 1980s, the Nuclear Regulatory Commission (NRC) and consultants for the Respondents (since the late 1990s), Engineering Management Support, Inc. (EMSI) have conducted several sampling and remedial investigation (RI) studies (NRC 1988; McLaren/Hart, 1996 a, b; EMSI 2000, 2010, 2011) within OU-1. The results of those investigations, analytical soil sampling data (e.g., McLaren/Hart, 1996a; EMSI, 2000) for the RADs of concern and overland gamma survey readings of radioactivity (McLaren/Hart, 1996b) are provided in the revised SFS Report. The consultants for the Site have used the results of previous investigations and sampling for evaluating the extent of the RIM areas to be capped and covered under the Record of Decision (ROD)-selected remedy and to estimate the RIM extent and volume of waste materials that would be excavated and disposed of offsite or on-site under the "complete RAD removal" alternatives.

Within the Strip properties (Figure 3), the RIM are found in soils believed to have been carried by erosion from the Area 2 berm prior to growth of the current onsite vegetation. Several color coded maps showing the existing sampled locations, known RIM boundary, extrapolated RIM boundary and No-RIM boundary are provided in Appendix B-2 of the SFS Report. Additionally, on February 23, 2014, a pdf file consisting of maps of the two areas and Strip properties was

provided by Mr. Vann. The pdf file consists of several new (not included in the SFS Report) gridded maps (February 2015) displaying the existing soil boring locations and overland gamma survey results (McLaren/Hart, 1996b) of radioactivity in OU-1. The soil boring locations are color coded in maps provided in the pdf file; locations shown in blue represent locations exhibiting RADs above levels that would allow unrestricted land use (Figures 5 through 10 below).

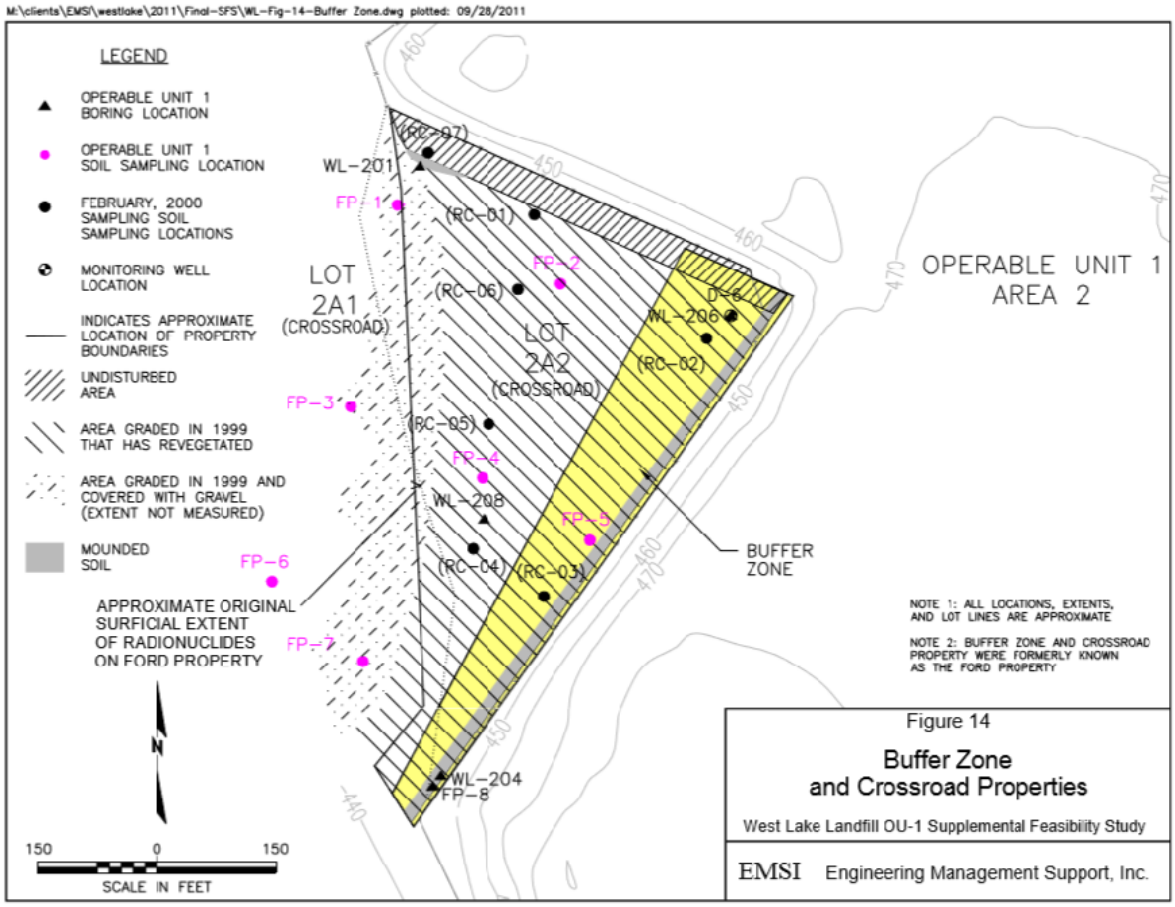

Figure 3. Buffer Zone and Crossroad Properties (Strip)

From these maps, it has also been learned that the soil boring locations with the two AOCs were selected using a grid pattern and a systematic random sampling design. The availability of data collected using a grid pattern is desirable and allows the use of geostatistical spatial methods (e.g., Kriging) for site characterization and determination of the extent of RIM. To address uncertainties, the Respondents could have used geostatistical methods to determine RIM extent and to estimate RIM volumes. Using the colored lines, some of these newer maps (e.g., Figure 7 and 10 below) also provide a comparison of the RIM extent identified during the years: 1982 through 2011. It is noted that the RIM extent boundaries have changed considerably over the years. Several poster Site maps displaying the existing soil boring sampling locations and known RIM extent (red lines), extrapolated RIM boundaries (magenta lines) and non-RIM boundaries (cyan lines) of the two AOCs were also provided by Mr. Vann. The soil boring locations are not color coded on the poster maps.

The information provided in the poster maps, maps from the SFS Report (e.g., Figures 1-2 displayed above) and from the pdf file (e.g., displayed in Figures 5-10 below) have been used to identify additional sampling locations. The existing analytical RAD data and the additional data collected from the proposed sampling locations can be used to perform geostatistical methods to statistically determine (estimate, extrapolate) the extent of RIM in the two areas of OU-1. All figures used in this TM displaying the maps of the three areas of the OU-1 have been re-numbered in this TM accordingly.

The following table from the SFS Report (2011) summarizes the maximum reported activity levels for the RADs of concern found in the previous investigations performed by the Site Respondents (labeled as RI) and the NRC.

Comparison of Radionuclides and Maximum Concentrations Detected During the RI and NRC Investigations						
Radionuclide	Maximum Concentration Detected During the Stated Investigation (pCi/g)					
	Area 1		Area 2		Buffer Zone/Crossroad Property	
	RI	NRC	RI	NRC*	RI	NRC
Uranium-238	147	No samples	294	2,900	4.17	No samples
Thorium-230	9,700	No samples	57,300	6,095	429	No samples
Radium-226	906	No samples	3,060	15,000	17.2	No samples

The following site cleanup values are described in the SFS Report to identify the site soils that would be included within the scope of the "complete RAD removal" alternatives.

- Radium-226+228 = 7.9 pCi/g
- Thorium-230+232 = 7.9 pCi/g
- Total uranium = 54.5 pCi/g

2.0 Objective

Till to date, no statistical methods (no models, surfaces) have been used on RADs data collected from the Site AOCs. The SFS Report does not use statistical methods to establish RIM extent and determine extrapolated RIM boundaries; therefore EPA personnel assigned to the Site are concerned about the unknown amount of uncertainty associated with the extrapolated RIM extent (e.g., shown in Figures 6, 7, 9 through 12) and estimates of RIM volumes described in the 2011 SFS Report. The EPA personnel (and also the Respondents) are considering collecting additional samples from the areas of the OU-1 (note the Strip is included in Area 2 maps) to delineate the extent of RIM using geostatistical methods and address uncertainty associated with the RIM volume estimates requiring excavation. Region 7 personnel want to quantify uncertainty

associated with estimated/extrapolated RIM extents in the areas of concern (AOCs) of OU-1. Specifically, RIM extent and RIM volume estimates need to be determined using statistical methods (e.g., geostatistical methods) which can quantify uncertainties with desired level of confidence (e.g., 90%, 95%,..); that is it needs to be demonstrated (e.g., with desired level of confidence such as 95%, 90%) that there are no RIM present (above background levels) outside of the estimated/extrapolated RIM extent (e.g., represented by cyan lines in Figures 6 and 9, and by magenta lines in Figures 11 and 12).

Due to the presence of RIM in surface and subsurface soils of Areas 1 and 2, the extent of RIM needs to be estimated for surface as well as subsurface levels. This will require: the availability of data providing sufficient (as determined by the Project Team/personnel associated with the Site) spatial coverage (lateral and vertical) of the AOCs and outer areas of the Landfill, and the use of geostatistical methods to delineate/estimate the extent of RIM in those areas of interest.

It is noted that that the status (unimpacted or potentially impacted above levels that would allow unrestricted land use) of the existing sampling locations is not displayed on the poster maps and on maps included in Appendix B-2. Therefore, poster maps are not used to identify locations for additional sampling. Information provided in the pdf file of the maps (shown in Figures 5 through 10 in the following) is the most useful in developing sampling plans for the Site AOCs. These maps have been used to identify sampling locations to collect additional RAD data from Area 1, Area 2 (including Strip).

3.0 Information provided by Poster Maps, Maps in the SFS Report and the pdf File

The poster maps are similar to the maps provided in Appendix B-2. However, some significant differences (e.g., different color scheme) have been noted in the poster maps and the maps (e.g., Figures 11 and 12 below) provided in Appendix B-2 and in the pdf file (e.g., Figures 6, 7 and 9, 10). For example, the known RIM boundaries (red lines) in the poster map and Appendix B-2 maps are different. The RIM boundary shown in the poster maps does not include all locations with RAD activities above levels which would allow unrestricted land use. It is further noted that the cyan lines representing the RIM limits shown in Figures 6 and 9 (from the pdf file) correspond to the magenta lines in Figures 11 and 12 (from SFS Report). The extrapolated RIM boundaries shown in Figures 6 through 10 also include most (not all) of the areas exhibiting elevated (greater than 2 x background) overland gamma survey readings of radioactivity.

Since the information provided by the poster maps, Appendix B-2 maps, and the gridded maps (e.g., Figures 5 through 10) from the pdf file have been used in developing a sampling plan to determine the extent of RIM boundaries outside the known RIM limit (e.g., red lines in Figures 11 and 12), initially all these discrepancies in the same maps provided in different documents caused some confusion. As noted earlier, maps provided in the pdf file are most useful and have been used to identify locations for additional sampling.

The following Figure 4 (from SFS Report) displays overland gamma survey results (without displaying soil boring locations) for the two areas and the Strip properties. From this figure, elevated levels of radioactivity are noted in some areas of the Strip properties and in Area 2. The

SFS Report maps and poster maps do not include this area within the extent of the RIM boundary.

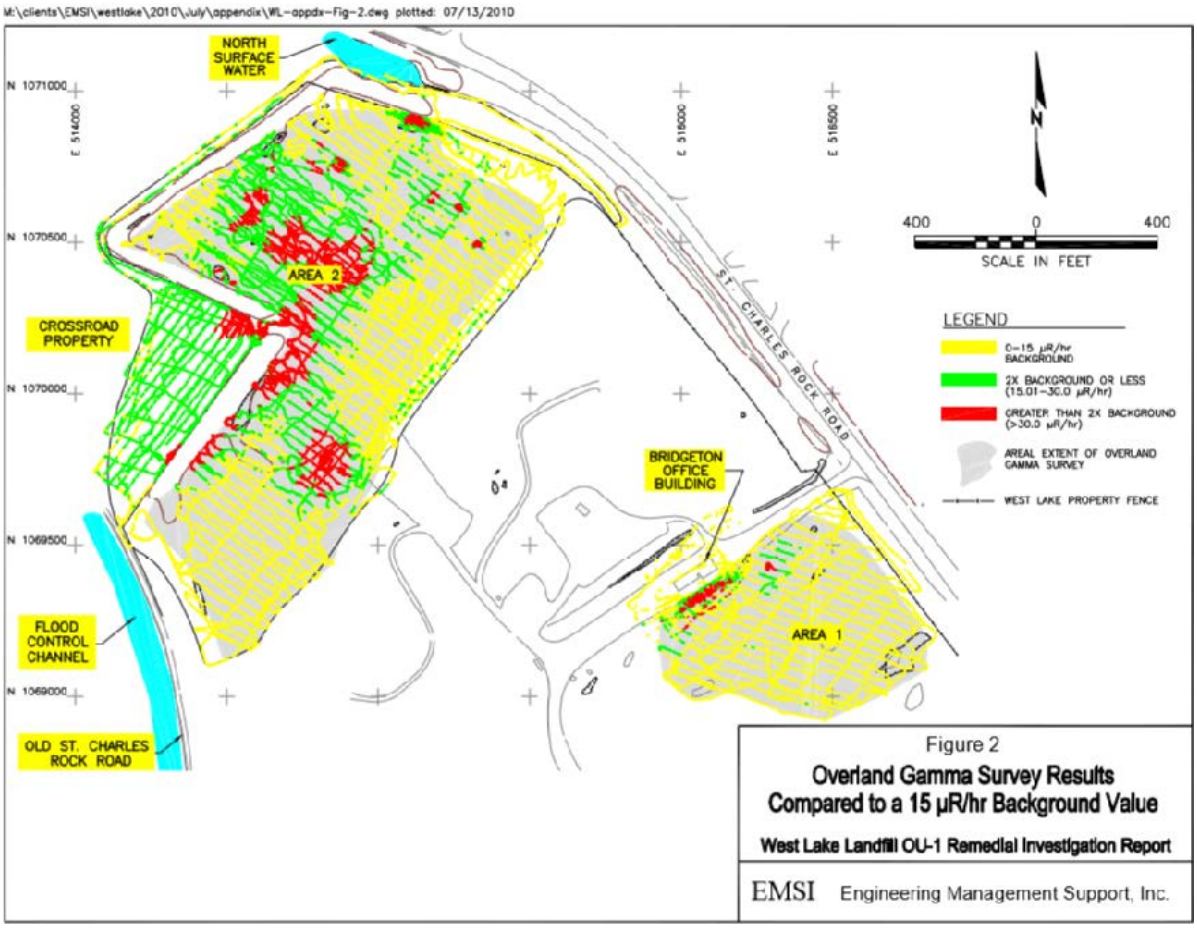

Figure 4. Overland Gamma Survey Results for Two Areas of OU-1 and Buffer Zone -Crossroad Property

Figure 5 is an Area 1 map showing the soil boring locations chosen using a systematic random sampling pattern; Figure 8 is a similar map for Area 2 and the Strip properties. Figure 6 is a map for Area 1 showing soil sampling locations, overland gamma survey readings, and the extent of RIM determined in 2011 (cyan line). In addition to information provided in Figure 6, Figure 7 also provides a comparison of the RIM extent in Area 1 determined during 1982 through 2011. Figure 9 is a map of Area 2 showing all soil sampling locations, results of the overland gamma survey and the extent of RIM determined in 2011. In addition to information provided in Figure 9, Figure 10 provides a comparison of RIM extent for Area 2 determined during 1982 through 2011. These maps are included here, as the information provided by these maps have been used to identify locations for additional sampling.

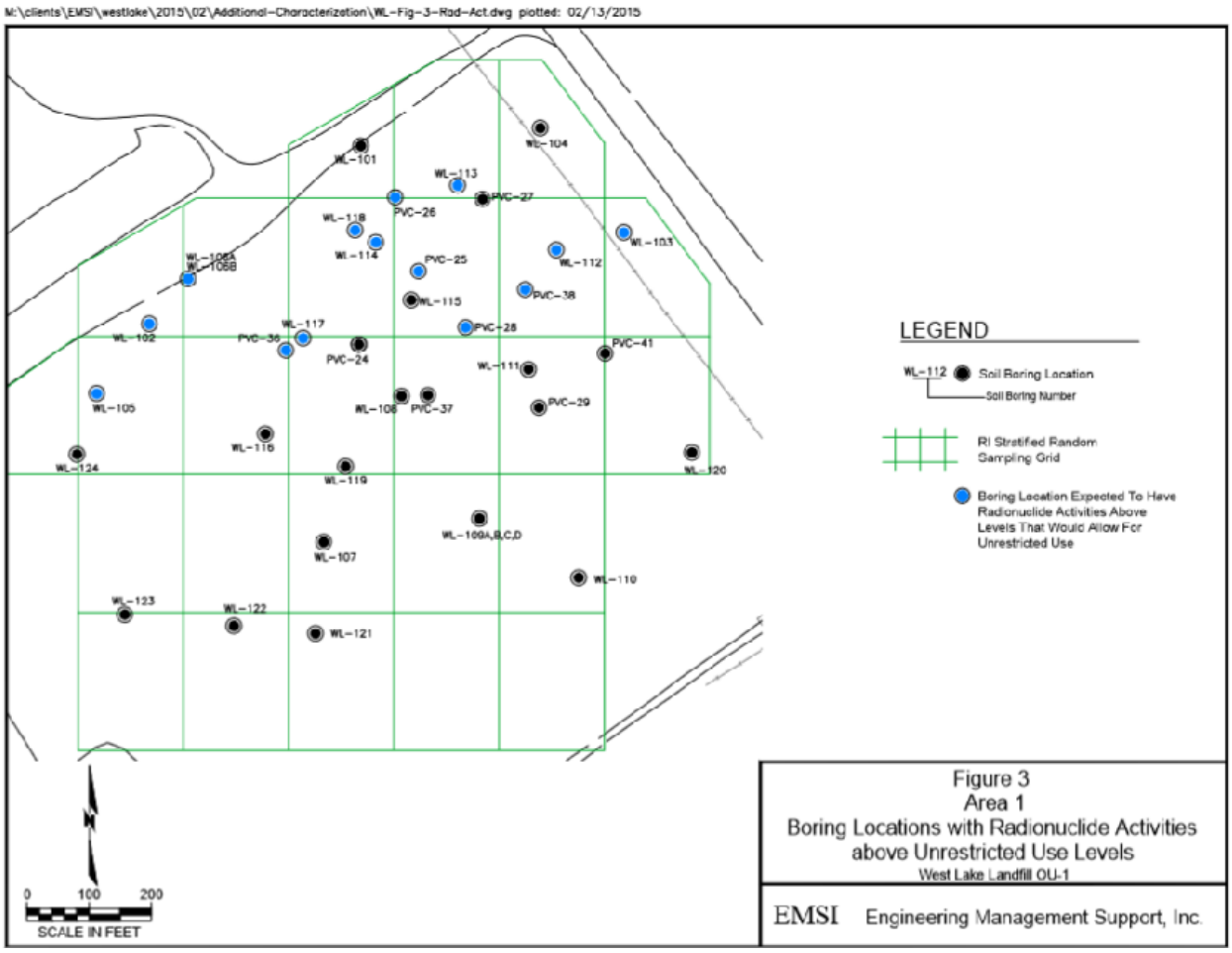

Figure 5. Gridded Soil Boring Sampling Locations for Area 1 of OU-1; Blue Locations Exhibit Activities above Levels Allowing Unrestricted Land Use

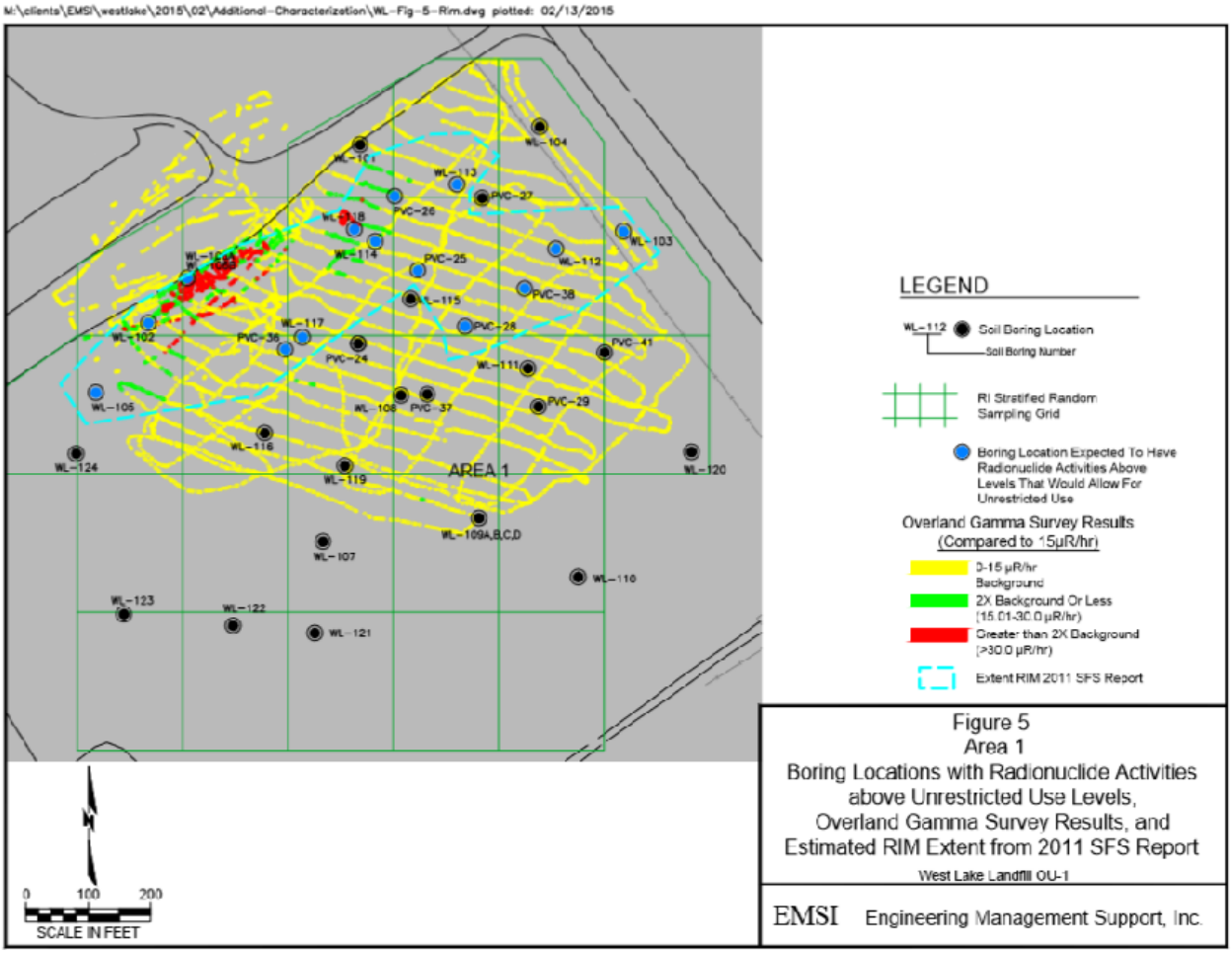

Figure 6. Gridded Sampling Locations and Overland Gamma Survey Results with Extent of RIM Boundary Determined in 2011 SFS Report - Area 1 of OU-1

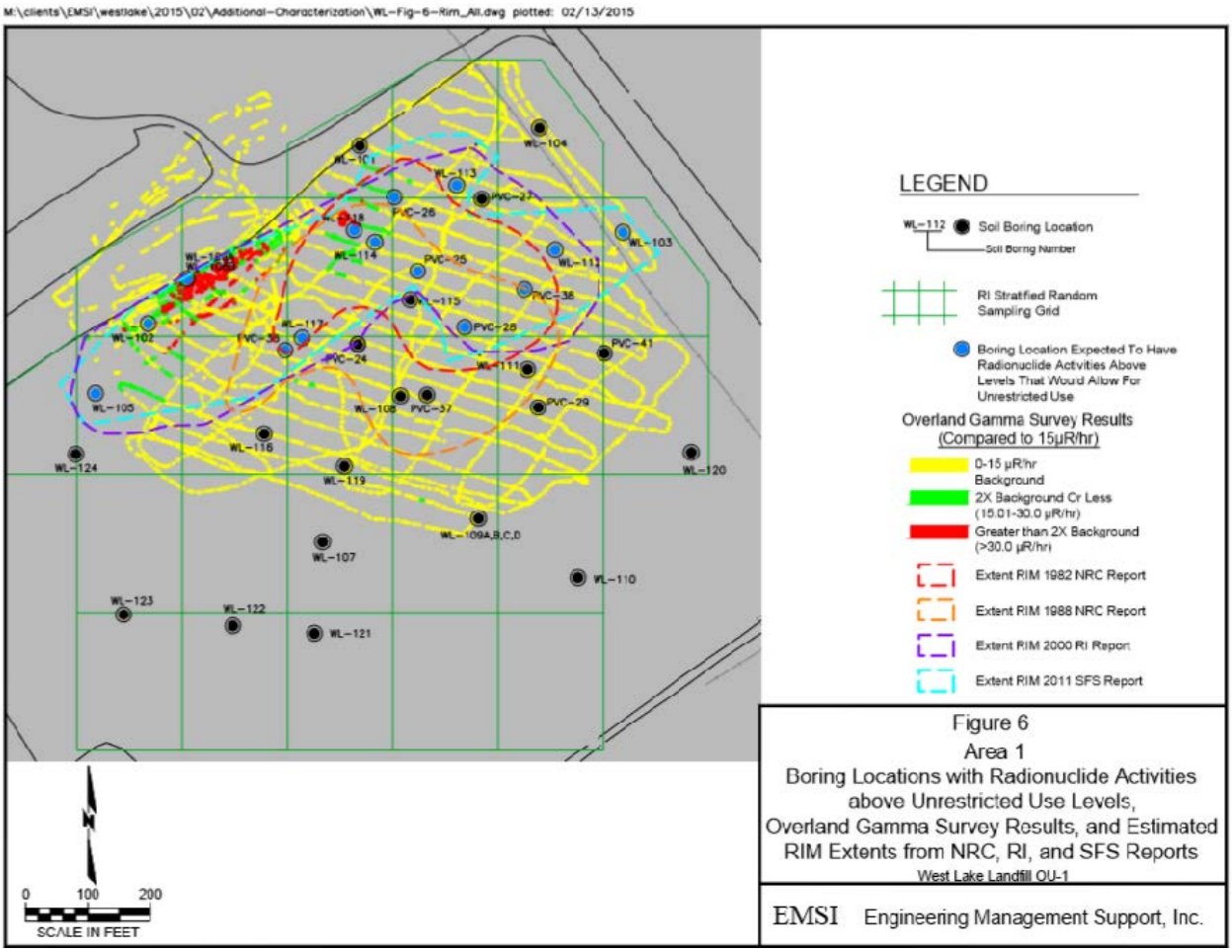

Figure 7. Gridded Sampling Locations and Overland Gamma Survey Results with Four RIM Boundaries Determined During 1982-2011 - Area 1 of OU-1

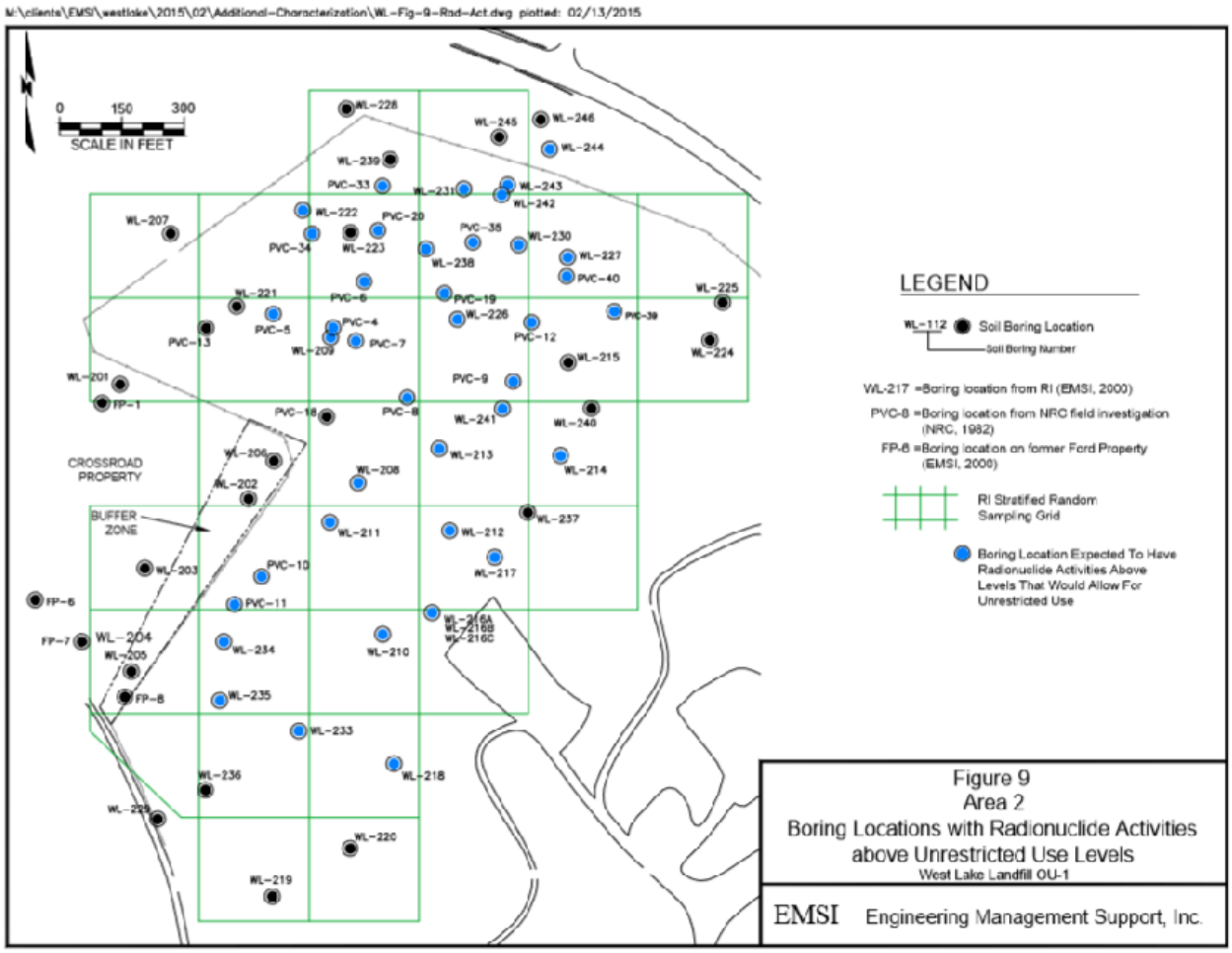

Figure 8. Gridded Soil Boring Sampling Locations for Area 2 and Strip Properties of OU-1; Blue Locations Exhibit Activities above Levels Allowing Unrestricted Land Use

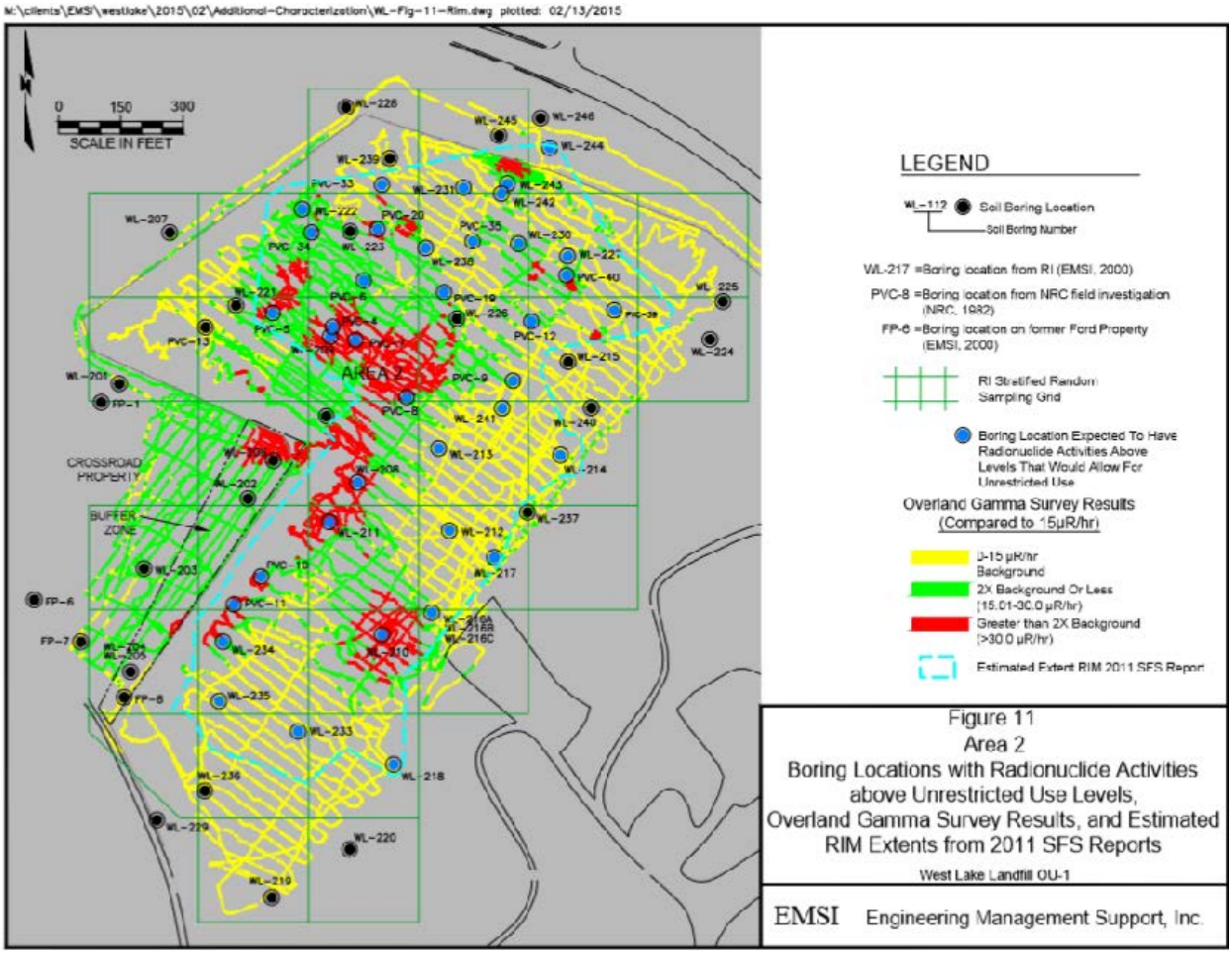

Figure 9. Gridded Sampling Locations and Overland Gamma Survey Results with Extent of RIM Boundary Determined in 2011 SFS Report - Area 2 of OU-1

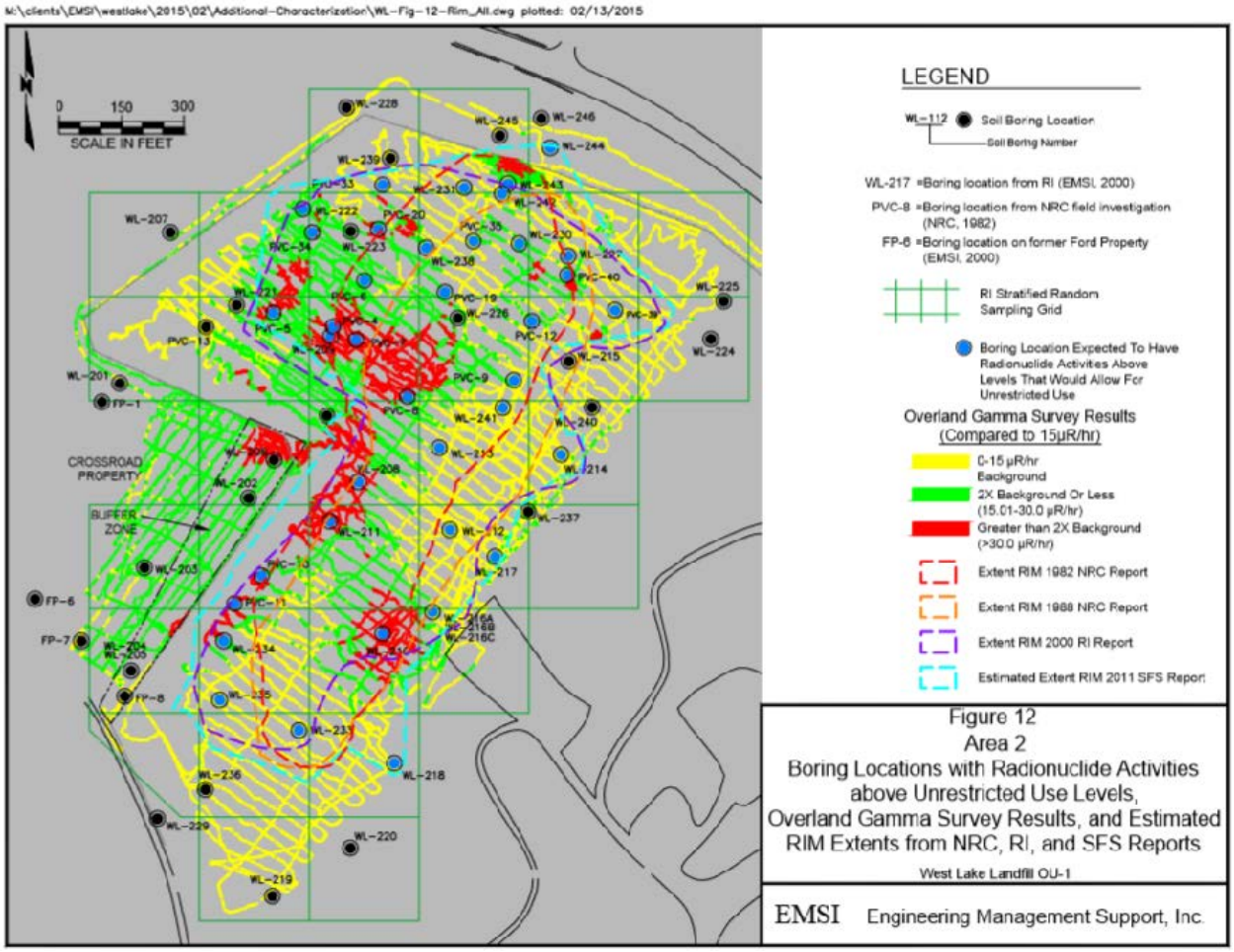

Figure 10. Gridded Sampling Locations and Overland Gamma Survey Results with Four RIM Boundaries Determined During 1982-2011 - Area 2 and Strip Properties

Figure 11. Area 1 Map Displaying RIM Boundary (Red), Extrapolated RIM Boundary (Magenta) and No RIM Boundary (Cyan)

Figure 12. Area 2 Map Displaying RIM Boundary (Red), Extrapolated RIM Boundary (Magenta) and No RIM Boundary (Cyan)

After reviewing all of the maps for the Site AOCs, it is determined that maps shown in Figures 11 and 12 are not useful in identifying additional sampling locations as these maps do not show all existing sampling locations and do not distinguish between unimpacted and impacted sampling locations. These maps are included here for information purposes.

4.0 Proposed Soil Boring Sampling Locations

The main objective of collecting additional data is to quantify uncertainties associated with extrapolated RIM extent and RIM volume estimates requiring excavation. To address these uncertainties, based upon the existing data and the new data collected from the proposed sampling locations, one would like to statistically demonstrate that there are no RIM present (above background levels) outside of the estimated RIM extent (in outer areas of the Landfill) with some desired level of confidence such as 95%, 90%, 80%. The use of geostatistical methods is proposed to delineate RIM boundaries and quantify RIM volumes present in the two AOCs and the Strip. Once kriged surfaces have been generated, contour plots with 90% or 95% confidence coefficient around kriged surfaces can be generated to quantify the uncertainties (with desired confidence level) associated with estimated RIM extents (kriged surfaces, models). When dealing with spatially collected data, uncertainty is addressed by contour plots (90%, 95%) drawn around kriged surfaces. For example, using a 95% contour plot around a kriged surface,

one can say that mean concentration of an analyte at an unsampled location will lie in an interval (a,b) with 95% confidence coefficient. Kriging yields exact values at sampled locations.

Note: From the maps provided in the pdf file (Figures 5-10), sufficient RAD data providing reasonable spatial coverage to areas within the Site (but not in outer areas of the Site) have already been collected using the systematic random sampling plan and geostatistical methods could have been used for RAD characterization and determining RIM extent within the AOCs of OU-1. However, to quantify RIM extent in outer areas, additional sampling locations have been identified as shown on Site maps which have been mailed to Mr. Vann.

The use of geostatistical methods (e.g., Kriging) requires the availability of data providing sufficient spatial coverage of the area requiring characterization; and it is desirable to collect data following a grid pattern (random or systematic). The Kriging (Isaaks and Srivastava, 1990) approach is specifically used when the objective is to characterize contaminant distribution within an AOC and delineate extent of contamination. The kriging approach estimates concentrations at unsampled locations based upon the concentrations observed at the neighboring locations. The use of this approach requires spatial information about the sampling locations (Easting, Northing coordinates). Once a kriged surface has been generated, contour plots can be drawn around the surface for desired level of confidence.

After reviewing the SFS Report and maps, it is noted that a considerable amount of data for the three RADs of concern have already been collected from the surface and subsurface of the two areas (especially Area 2) and the Strip properties. To address uncertainties associated with the extrapolated RIM extent, additional sampling locations have been identified to provide sufficient spatial coverage around the extrapolated RIM boundaries and to include areas with elevated overland gamma survey results. A total of 8 sampling locations have been selected in Area 1, and 17 sampling locations have been selected in Area 2 including the Strip properties (see Attachment A; new sampling locations marked in magenta). Most of the locations have been selected near the extrapolated RIM extent (e.g., cyan lines in Figure 6 and 9) and near areas exhibiting high (e.g., >2*background) overland gamma survey readings of radioactivity.

The spatial data set consisting of the existing RAD data and data from the new sampling locations will be adequate to use geostatistical methods to characterize RIM contamination and determine the extent of RIM in the two AOCs and the Strip properties. The personnel assigned to the Site and experts familiar with the Site geology and topography may want to relocate the proposed sampling locations as deemed necessary. Sampling data need to be collected from surface and subsurface soils and geostatistical methods may be used separately to determine the surface and subsurface extent of RIM. The upper (surface) and lower (subsurface) kriged surfaces can be used to compute volume estimates of waste material potentially requiring excavation. Geostatistical code available in R script can be used to perform spatial analysis on the data set consisting of the existing and the new RADs data.

The gridded maps displaying sampling locations and overland gamma survey results, and some other maps (e.g., Figures 11 and 12 above) from Appendix B-2 showing the extrapolated RIM boundaries were enlarged. The proposed sampling locations are marked in magenta on the maps in Attachment A.

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ATTACHMENT A

SAMPLING LOCATIONS FOR COLLECTING ADDITIONAL SOIL SAMPLES TO DELINEATE THE EXTENT OF RADIOLOGICALLY IMPACTED MATERIALS PRESENT IN AREA 1, AREA 2, AND BUFFER ZONE/CROSSROAD PROPERTIES OF OPERABLE UNIT -1; WEST LAKE MUNICIPAL LANDFILL SITE, BRIDGETON, MISSOURI

MARCH 2015

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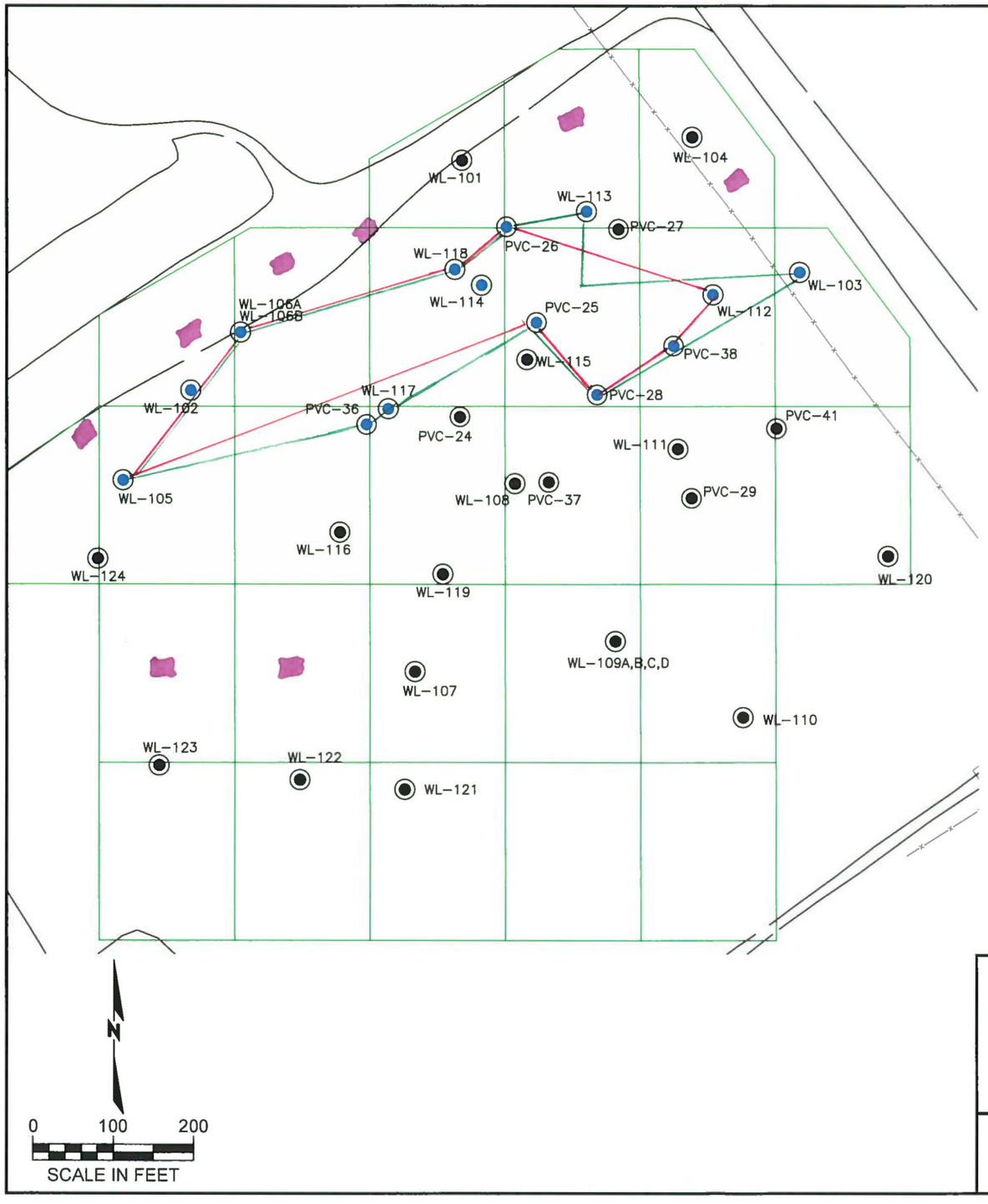

LEGEND

WL-112 Soil Boring Location
Soil Boring Number

RI Stratified Random Sampling Grid

Boring Location Expected To Have Radionuclide Activities Above Levels That Would Allow For Unrestricted Use

Figure 3
Area 1
Boring Locations with Radionuclide Activities above Unrestricted Use Levels
West Lake Landfill OU-1

EMSI Engineering Management Support, Inc.

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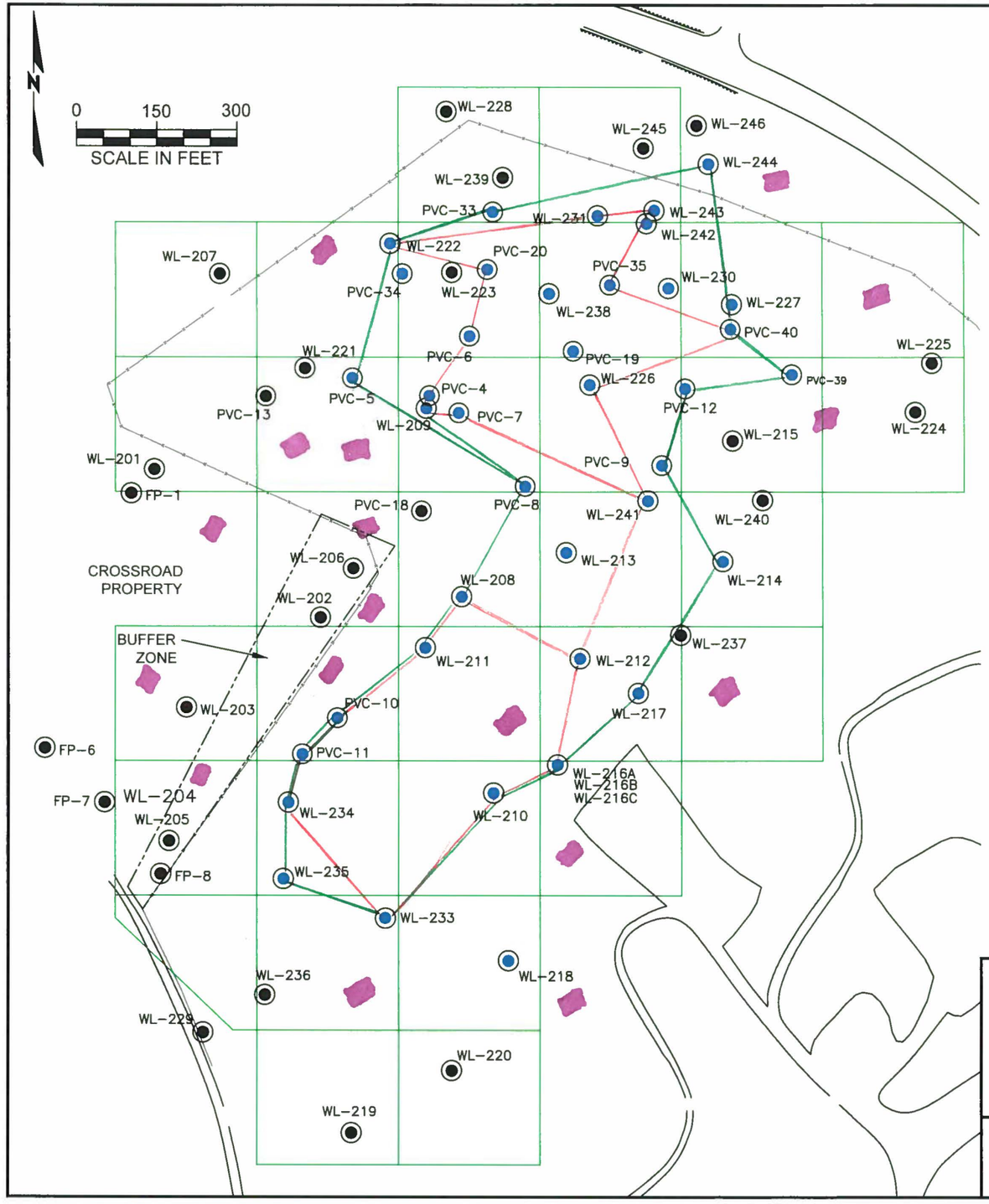

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WL-112 ◉ Soil Boring Location
Soil Boring Number

WL-217 =Boring location from RI (EMSI, 2000)

PVC-8 =Boring location from NRC field investigation (NRC, 1982)

FP-6 =Boring location on former Ford Property (EMSI, 2000)

RI Stratified Random Sampling Grid

Boring Location Expected To Have Radionuclide Activities Above Levels That Would Allow For Unrestricted Use

Figure 9
Area 2
Boring Locations with Radionuclide Activities above Unrestricted Use Levels
West Lake Landfill OU-1

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